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SAFETY AT WORK AND OCCUPATIONAL HAZARDS 1/

by

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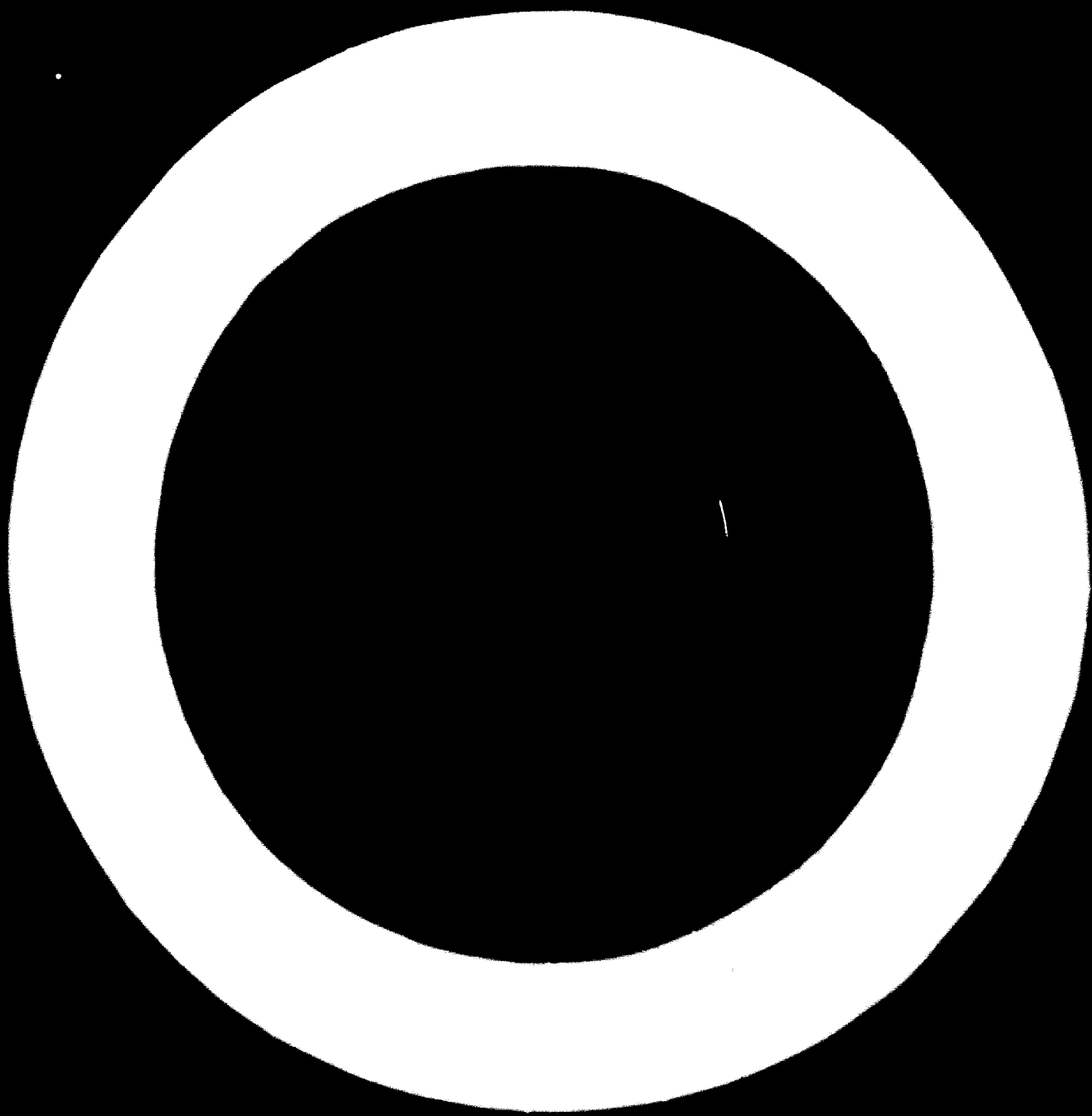
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1. Safety promotion at industrial plants

The purpose of safety promotion is to protect the employees from becoming exposed to occupational hazards. These can be divided into groups: accidents and occupational diseases. An accident means here an injury that has occurred at work within a relatively short space of time. Occupational diseases are illnesses caused by physical or chemical factors of occupational origin, such as noise, dust or dissolvers of paints.

Consequences of accidents and occupational diseases:

- Temporary or permanent partial or complete loss of working ability of the injured person.
- Death.
- Sufferings and economical losses of the injured person and his relatives.
- Disturbances and damages caused by the accident to operation of the firm in question.

In most countries the legislation sets obligations to the employer in defining certain minimum requirements a work-shop must meet to prevent accidents and occupational diseases. A well-managed company will not only fulfil these minimum requirements but also tries with all available means to make the working conditions as safe as possible. This

so-called voluntary accident prevention is carried out since more and more industries have understood that preventing the accidents is both economically profitable and a moral obligation of an employer. Therefore we often talk of the three motives of voluntary safety promotion, i.e. moral, judicial and economical motives.

The degree of safety at work depends decisively on both the management, all different grades of supervisors, and workers of a company. Industrial enterprises with a small personnel do not need a special safety organization but every foreman must, beside his other duties, see that questions concerning safety at work are attended to. Further on, cooperation on a wide basis is a condition of effective safety promotion. It is of special importance that the workers take part in this operation. Safety committees with representatives of the management, supervisors and workers make the cooperation systematic. The tasks of the safety committee are to receive and give information, to deal with safety matters and to give out statements. The safety committee has no executive power, nor can it be given the responsibility for safety at work. The safety committees have proved useful in industrial plants of all capacities.

The internal safety activities of an industrial establishment consist of a large field of operations. In the following only the most important of these functions are mentioned, viz 1) statistics and internal accident reports, 2) safety inspections, 3) training and 4) safety propaganda.

1) An internal accident report, which the foreman makes after each accident, serves three purposes: it forces the foreman to get acquainted with every accident that occurs under his supervision, it guarantees that the management of the department and the factory is informed about all accidents and it gives a basis to statistics about accidents. The accident statistics are an important guide to the necessary safety measures and they show the development in the frequency and severity of accidents.

2) In addition to the safety inspections of the authorities, insurance companies and other outsiders every industrial establishment should organize their own internal inspection program. The aim is to eliminate existing occupational hazards in the plant. Every inspection should be reported in writing.

3) There is a great variety of methods for an efficient audio-visual safety training and propaganda, as e.g. safety meetings, films, safety exhibitions and rescue displays. These activities are often concentrated to make safety campaigns or safety weeks.

Also safety competitions have proved to promote positive interest for the prevention of accidents.

4) Safety posters and pamphlets are commonly used even in the smallest work-places to give information on safe working methods or just to promote safety in general.

2. Prevention of occupational hazards in the furniture and joinery industries

The accident frequency in different occupational groups in Finland is highest in stevedoring works (205.0 accidents/1 mil workhours). They are followed by construction works (109.4), mechanical work-shops (102.0), sawmills (95.8), underground work in mines (94.1) and joinery with machines (89.6). The accident frequency in joinery without machines is much lower (56.8). It seems justified to point out that the joinery industries should show more interest in accident prevention and especially in safer working conditions.

I consider the guarding of machines and the skill of their operators the most important matters in preventing severe hazards in joinery industries, but attention must be paid also to preventing hazards caused by dust, paint and lacquer.

2.1 M a c h i n e s

When estimating the hazards produced by machines and the necessary technical safety measures, consideration must be given to the differences in carefulness, professional skill, intelligence, training and attentiveness among the people working at the machine or in its vicinity. Defects in these characteristics are causes of accidents, which are often said to be caused by the so-called human factor or mistakes made by man. Anyhow, many of these accidents are also due to the dangerous characteristics of the machines.

The technical safety measures for machines are intended to prevent the mistakes that man makes, and which never can be completely avoided, from leading to an accident. So the planning, structure or installation of every machine and every part of a machine must be such that working at it or near it can be done with largest possible security considering accidents and diseases. The less skilled the workers are, the more important is this requirement. Since the labour of small plants is of a very mixed training and professional skill, the machines must be really safe here.

When speaking of wood-working machines, additional attention must be paid to the fact that they are to be considered as dangerous machines, which must not be operated by other than skilled and experienced workers. In Finland there is a ban on persons under the age of 16 years operating woodworking machines.

In table 1 the accidents in the joinery industries are classified according to the agency of the accident based upon the statistics of Keskinäinen yhtiö Teollisuusvakuutus (Industrial Mutual Insurance Company). From these statistics it is easy to calculate that each worker has been absent from work 2.7 work-days a year on an average because of an accident at work. Of these 2.7 days, 1.1 days are caused by circular saws, smooth planers and millers, 0.4 days by other woodworking machines and 1.2 days by other reasons. It is apparent that special attention must be paid to those 3 groups of woodworking machines; that is to say circular saws, smooth planers and millers.

General

As common safety requirements for all woodworking machines, the power transmissions must be completely guarded and the machines must have a switch, which cuts off the current when the voltage decreases. The switch must be of such construction that the machine does not start by itself when the power supply is re-energized. Most woodworking machines must also be equipped with a brake, which quickly stops the blade or other moving parts when the power is cut off.

Circular saws

Accidents caused by circular saws can be divided into two groups accordingly to the way they occur.

- touching the saw blade
- kick-backs

In most cases accidents of both types can be prevented by technical measures although correct working methods are important too.

Touching the saw blade most often occurs when the sawyers hand slips into the blade either when he holds his hands too close to the blade during the sawing or when he removes waste from the side of the blade or from under it. The sawyer can also fall on the blade if he staggers or stumbles near the saw. All these types of accidents can usually be prevented by guarding the blade both above and beneath the sawing level.

The lower part of the blade under the sawing level can usually be guarded without any inconvenience. The under guard is usually a fixed enclosure but it should be so constructed that it can easily be removed either partly or entirely for the changing of the blade. The other side of the guard should preferably be hinged so that the blade can be changed without removal of the whole enclosure, fig. 2.

Kick-backs are a dangerous factor in the use of circular saws, and they may cause serious accidents. So attention has to be paid to their prevention. Kick-backs are caused by internal tensions released from the wood during the sawing, so that the kerf closes during the sawing. This permits the material to pinch on the back of the blade, and to rise on the top of the blade, where it is flung back with great force. This happens so quickly that the sawyer has no time to parry the kick-back. The same occurs if a board falls on the blade. To prevent kick-backs, every saw that is used for lengthwise sawing has to be equipped with a spreader or at least double anti-kick-back fingers. A substantial upper guard which is placed low enough prevents kick-backs top.

The spreaders must be made of steel and approximately so thick that it just fills up the kerf and so wide that it is stable enough. The shape of the front side of the spreader knife should follow the shape of the blade. The spreader knife should be easily adjustable both vertically and horizontally so that the distance between the knife and the blade is at the most 3 mm and so that it extends (vertically measured) at the most 5 mm under the top of the biggest blade, fig. 3.

A rip saw has to have an upper guard which prevents touching the blade, falling of boards on the blade and also kick-backs. The upper teeth of the blade must be inside the guard during the sawing. The length of the guard must be longer than the diameter of the biggest blade, fig. 1 and 2.

In small rip saws, which do not have feed rolls, the upper guard and the spreader together must cover the whole upper and rear part of the blade. The upper guard must be easily adjustable according to the height of the object worked on or it must follow the object during the sawing, fig. 2 and 4.

If the saw is equipped with feed rolls, they have to be guarded from the front, sides and above. In front of the rolls there must be a safety bar with which the rolls can be stopped fig. 1.

The blade of a balance cross-cut saw cutting from underneath must not be one that can be lifted with the foot. The handle used for the lifting of the blade has to be situated so that the sawyer does not have to stand in front of the blade where his hand can touch the blade. In its lowest position the blade must be completely covered with a closed encasement. The balance cross-cut saw lifted from underneath should be so balanced that when the grip from the handle is let loose the blade drops inside the protective encasement without bouncing up.

A cross-cut saw cutting from above, must have an upper guard, which encloses the upper part of the blade. Attached to the

front of this guard there must be an additional guard, which rises and falls by itself according to the thickness of the board to be cut, fig. 5.

Band saws (Fig. 6)

Band saws can be considered safer than circular saws because there is no danger of a kick-back. Thus the most important risks when using band saws are:

- 1 Touching the blade or power transmissions with the hand or some other part of the body.
- 2 Dangers caused by the breaking of the band blade.

All the moving parts of a band saw should be completely guarded. Plate wheels are usually considered safer than spoke wheels where the spokes can easily cause accidents if a piece of wood or clothing gets stuck in them. Whichever type of wheel is used, the wheels should be completely enclosed so that the protective casing at the same time prevents a broken sawblade from causing any accidents.

The blade should be completely covered except at the actual sawing point. The return side of the blade must be guarded over its whole length and completely enclosed.

On the sawing side the blade must be guarded from the upper wheel to the blade-guide with a guard that covers the blade at least from the front and outer sides. This guard has to be adjustable so that regardless of the height of the blade-guide the guard always covers the whole distance between the wheel and the blade-guide. The guard can be attached to the saw guide so that it automatically follows the guide.

Smooth planers

Accidents occurring during planing are usually caused by a knot or some other hard spot on wood which prevents the piece of work from moving on smoothly. When resistance grows rapidly the planer is not able to react quickly enough but his hand gives way causing the piece of work in hand to bounce back and his hand to slip to the cutter. Often an accident is caused by a wrong hold of the piece of work. If the hold is weak or unsteady, the slightest shock will be sufficient to allow the hand to slip to the cutter. Positioning hands so that they almost touch the surface of the table naturally leads to cutting off of the fingertips as soon as they reach the cutter.

For safety measures it is important that a smooth planer is fitted with a round cutter with shavings crushing gutters as narrow as possible, fig. 7. Further on, a smooth planer must have a cutter guard which is easy to use. For safety the best guard conceals the cutter slit also when being used, with the hand gliding over the guard during the planing process. This will also prevent fingers from slipping to the cutter as a result of a kick-back, as well as the accidents caused by the wrong position of fingers on the piece of work in hand. The SUVA-guard is an example of this type of a safety guard, fig. 8.

For protective properties poorer than the above mentioned guards but perhaps better in use are so-called boomerang guards. In these the guard conceals the cutter slit all the time except at the moment of planing when the piece of

work pushes the guard aside. Even then only a part of the cutter, no bigger than the width of the piece to be planed, remains uncovered. Pressing of the guard against the steering ruler is caused by a counterweight or a spring. Further on, smooth planers must always be fitted with a brake which limits the rotating time to 10-20 seconds after the power is switched off, and also with a back guard which covers the part of the cutter behind the steering ruler.

The mechanical feeding device has proved to be the outstandingly best guard in use in both planers and other wood-working machines. It gives perfect protection to the cutter and is free of properties impeding work.

Milling machines

Milling machines are the most dangerous machines in joinery. The accidents are usually caused either by a kick-back or by slipping of fingers to the cutter some other way.

Due to many different usages of a milling machine it is impossible to use one general guard only. Therefore in guarding a milling machine a separate protective device must be designed for each usage. Figures 9 and 10 show an example of a Swiss SUVA-guard which is practical, versatile and can be applied to almost all usages of the milling machine. Its one disadvantage is the need to adjust the guard to a desired protective position for each working phase separately. Because of this inconvenience the guard has not become popular in Finland. The mechanical feeding

device has proved the best and most practical cover also for the milling machines.

2.2 D u s t

The dust caused by woodworking machines should be removed **not only** because of the danger of explosion and fire it causes but also because the dust of some tropical wood species like teak and mahogany can cause illnesses, which can take the form of allergic nasal catarrh, asthma or dermatitis. For removing the dust the saws must be equipped with a fixed exhausthood, which is connected to an exhaust system. In many cases the exhaust-hood can be built together with guards, eg. the under-guard of a rip saw. The exhaust system must include a dust precipitator located outside the workshop.

2.3 P a i n t s a n d l a c q u e r s

Solvents used in many paints and lacquers may cause dermatitis by contact and poisonings when breathed on great doses. Also many so-called 2-component lacquers and -glues have strong properties which cause dermatitis.

To prevent dermatitis contact with these materials must be avoided and attention must be paid to special cleanness and hygiene at work. Solvents should not be used for washing hands.

Solvents used in most paints and lacquers are also highly

combustible. To prevent poisoning and danger of fire the work-shops where paints and lacquers are used must have a good ventilation.

In spite of the ventilation benzol must never be used as a solvent in painting, lacquering or cleaning, due to its highly poisonous properties. Also other solvents, toluene in the first place, may contain benzol in dangerous amounts, and a buyer should demand a guarantee of the benzol content not exceeding a certain limit. An acceptable limit would be the maximum of 3,0 % of benzol.

Painting and any other work where handling of materials dangerous to health is implied should be done in a painting box with a sufficient amount of air to be exhausted to make the velocity of air in the front opening of the box at least 0,5 m/sec.

In this lecture I have discussed some important aspects in preventing occupational hazards in joinery industries. In spite of the necessity of the technical safety measures mentioned above, it is obvious that all accidents cannot be prevented by them. Also unsafe acts and dangerous working methods have to be changed and improved. Unsafe acts can depend on carelessness, foolhardiness, lack of skill or experience or even on stupidity. On the other hand, missing instructions or insufficient training are often reasons for wrong working methods. That is why also training and guidance is needed for the prevention of accidents.

Whether it is a question of either technical measures or train-

* Crude benzene.

ing, the management of a plant always has the **final** responsibility for the prevention of accidents. This responsibility, which does not depend on the size of the enterprise, is discussed very clearly in a booklet published by the Central Federation of the Finnish Employers:

"The management of an industrial enterprise is responsible for the promotion of safety. But in addition to the so-called formal responsibility, a positive attitude of the management is of utmost importance when preventing occupational hazards. Such an attitude is always needed, regardless of the size of the enterprise or of other factors. Anyhow it is important to point out that a positive attitude is something much more than simply realizing a legal or economical responsibility. A positive attitude means, *inter alia*,

- that the management of an enterprise completely realizes the importance of safety promotion both in general and especially regarding their own plant,
- that the management takes action to give evidence for their positive attitude
- that the management makes efforts to get the various levels of the plant organizations as i.e. foremen and workers in a close cooperation in safety problems".

TABLE 1. Classification of accidents in joinery (Statistics of Industrial Mutual Insurance Company, Finland).

Agency of accident	Number of accidents		Number of days lost		Number of cases with permanent partial disability	Number of days lost per accident
	Number	%	Number	%		
Circular saws	121	15.0	2316	14.3	3	19.9
Smooth planers	103	12.8	2252	13.8	3	21.8
Millers	64	8.0	2044	12.6	4	32.0
Total	288	35.8	6612	40.7	10	23.0
Other woodworking-machines	126	15.7	2276	14.0	2	10.1
Total: all wood-working machines	414	51.5	8888	54.7	12	21.2
Others	330	48.5	7400	45.3	8	18.9
Total: all accidents	604	100	16288	100	20	20.2

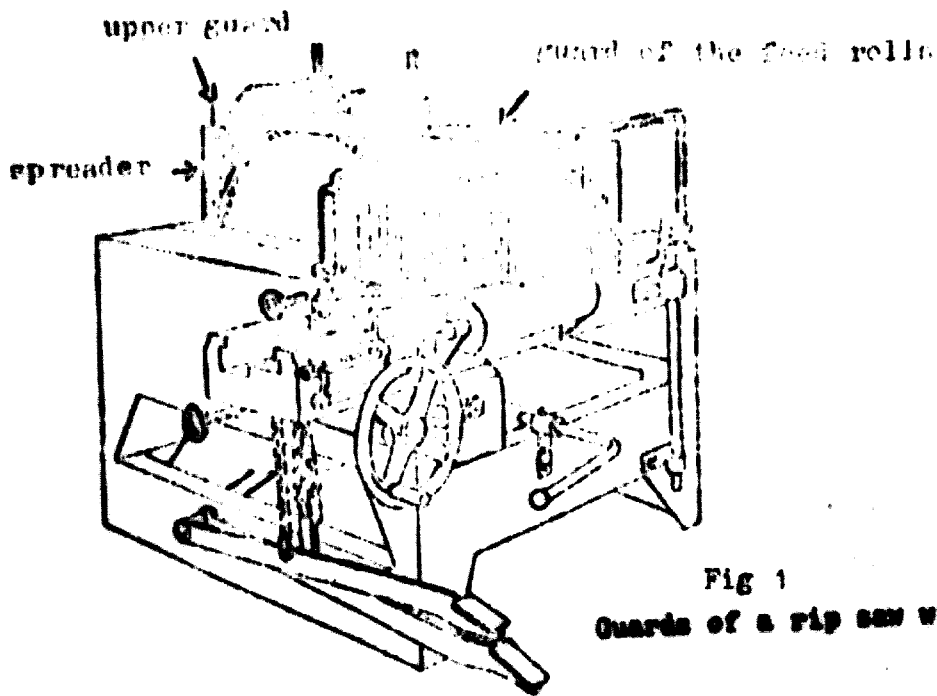


Fig 1
Guards of a rip saw with feed rolls

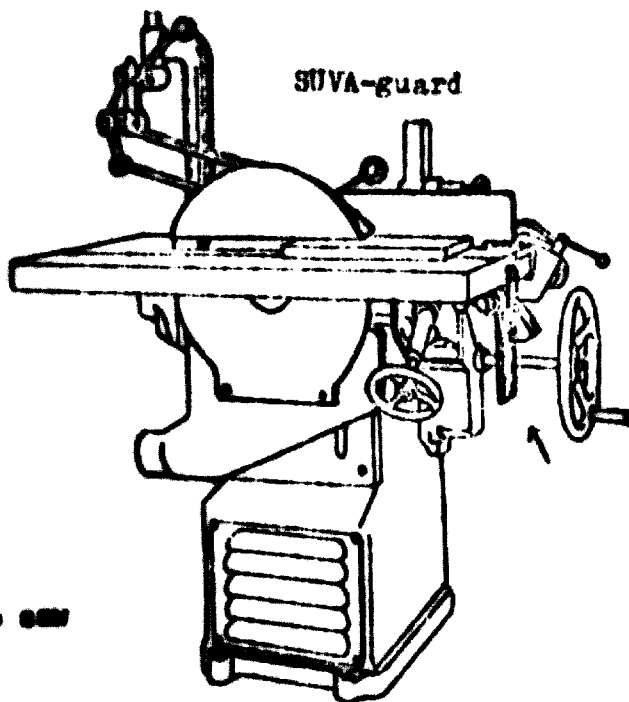
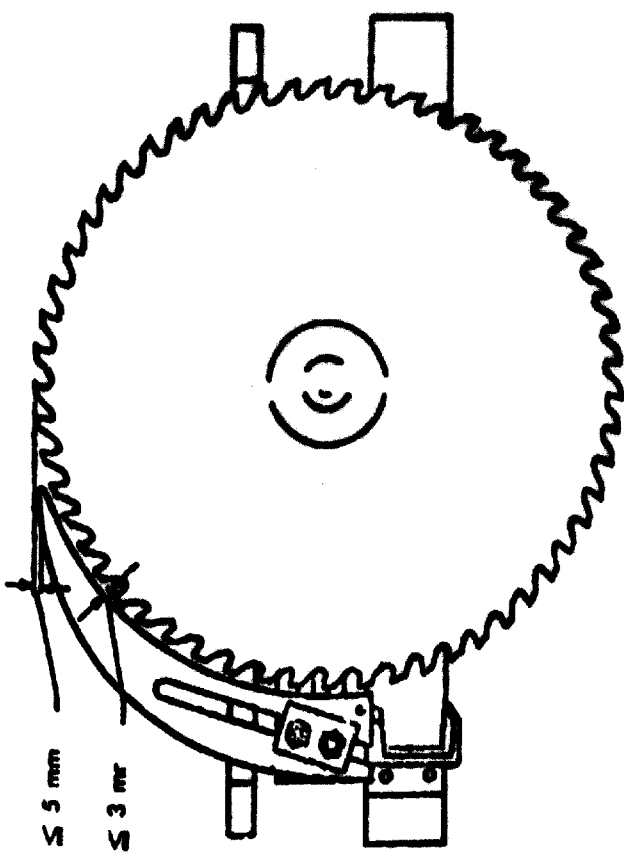
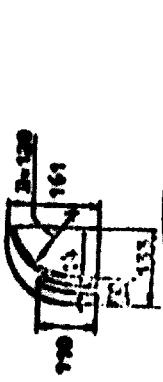


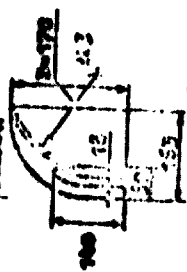
Fig 2
Guards of a small rip saw



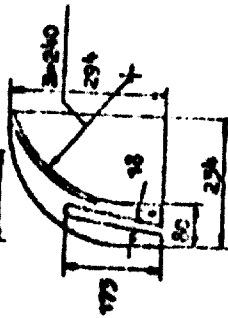
For blades
 ϕ 175-200 mm



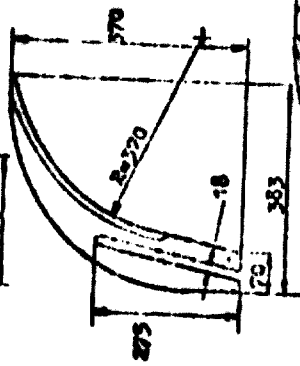
For blades
 ϕ 250-350 mm



For blades
 ϕ 350-500 mm



For blades
 ϕ 500-800 mm



For blades
 ϕ 800-1000 mm

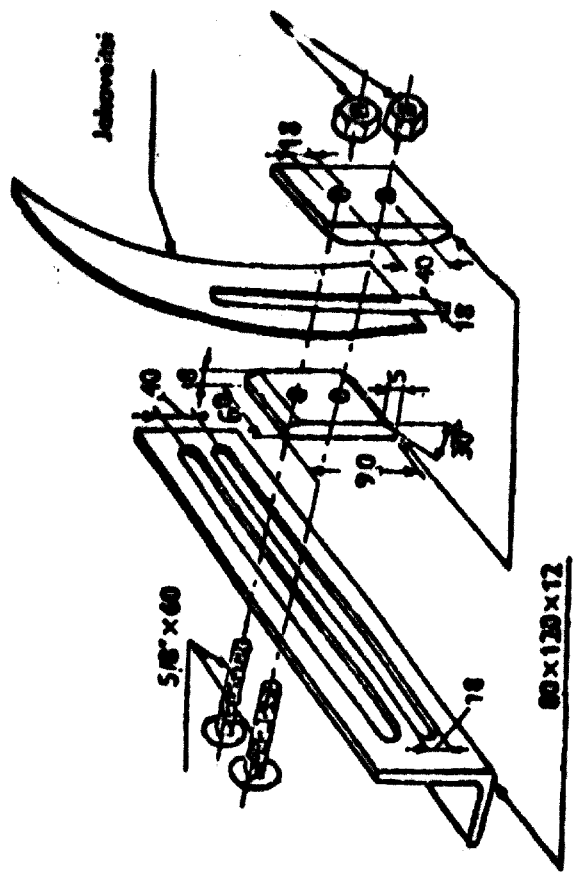
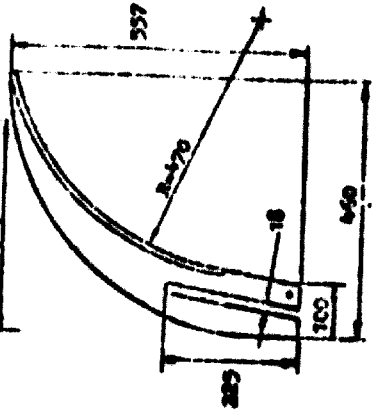


Fig 3

Spreader for a rip saw

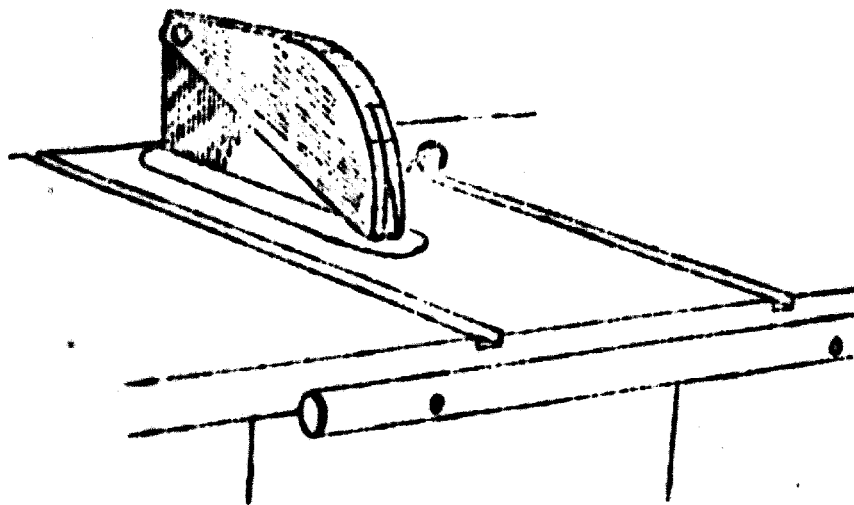


Fig 4 The guard (type 311VA) can be locked at the desired position

Upper guard for a small rip saw

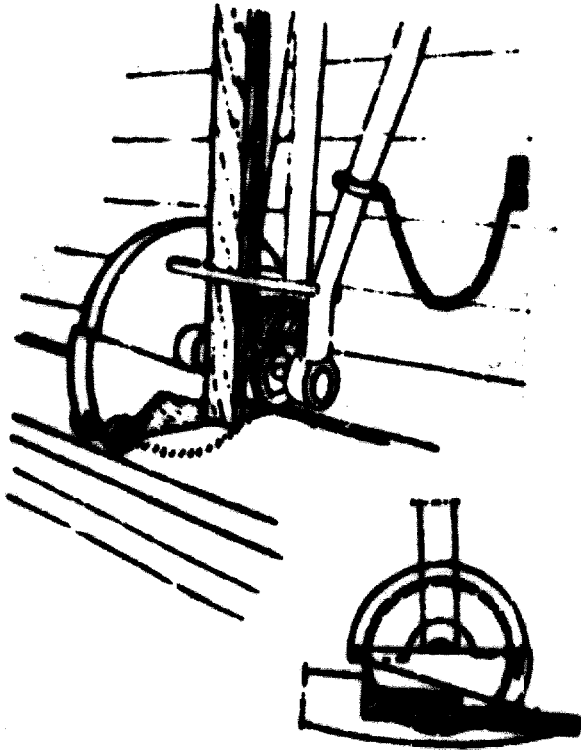
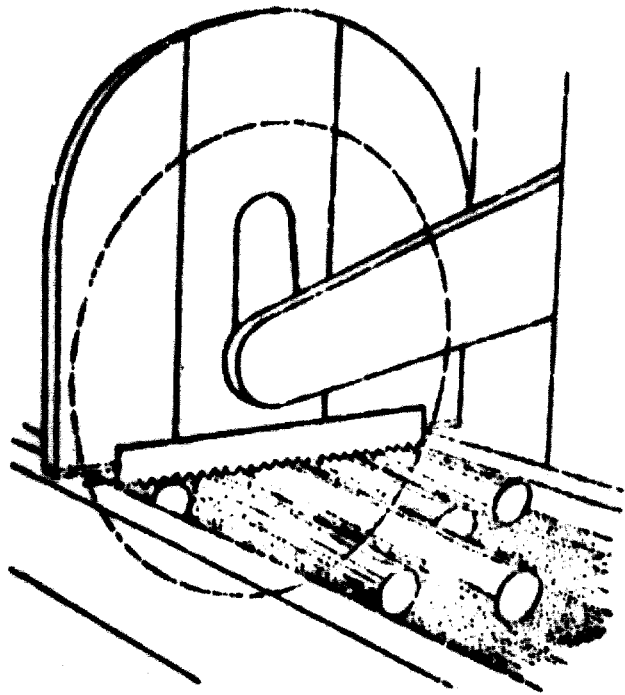


Fig. 5
Upper guards for cross-cut saws

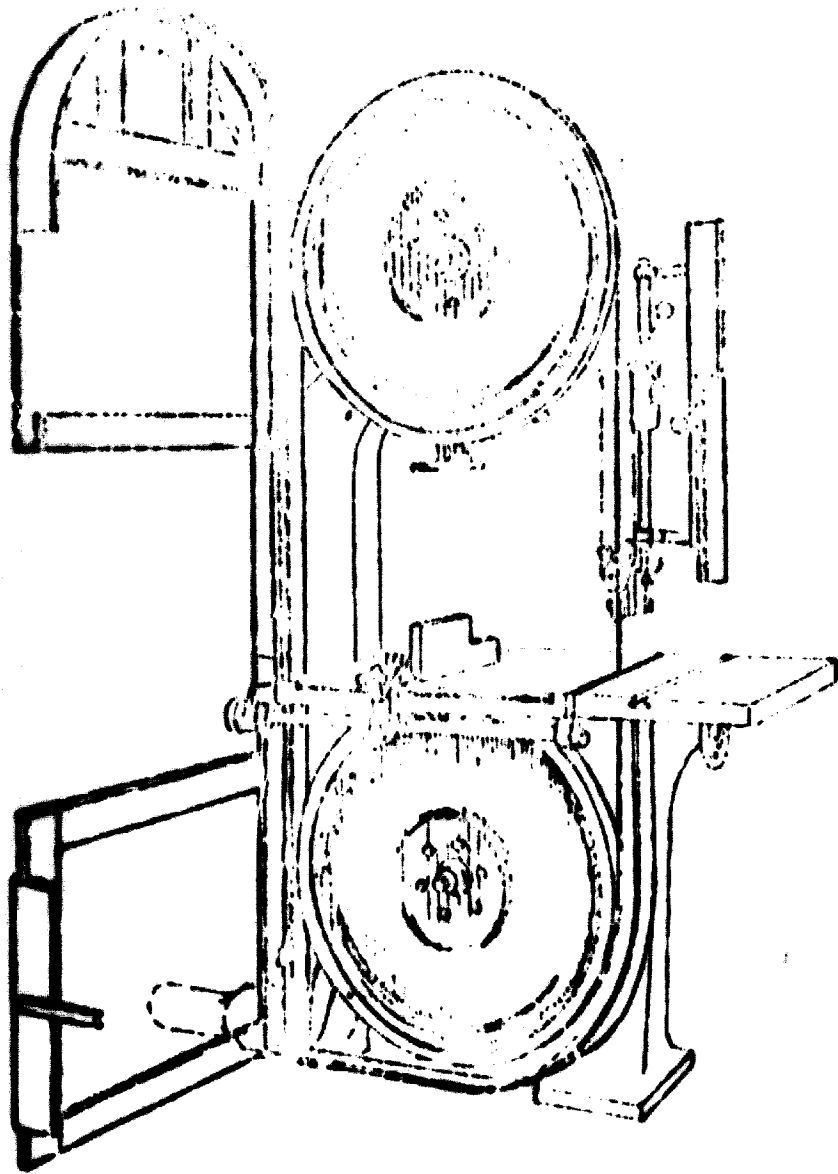


Fig. 6
Guards of a band saw



Fig. 7

Circular cutter with knives. The dimensions A, B and C should be as small as possible. They should not exceed 10,3 and 4 mm. Absolute maximums: A = 13 mm, B = 4 mm. and C = 6 mm.

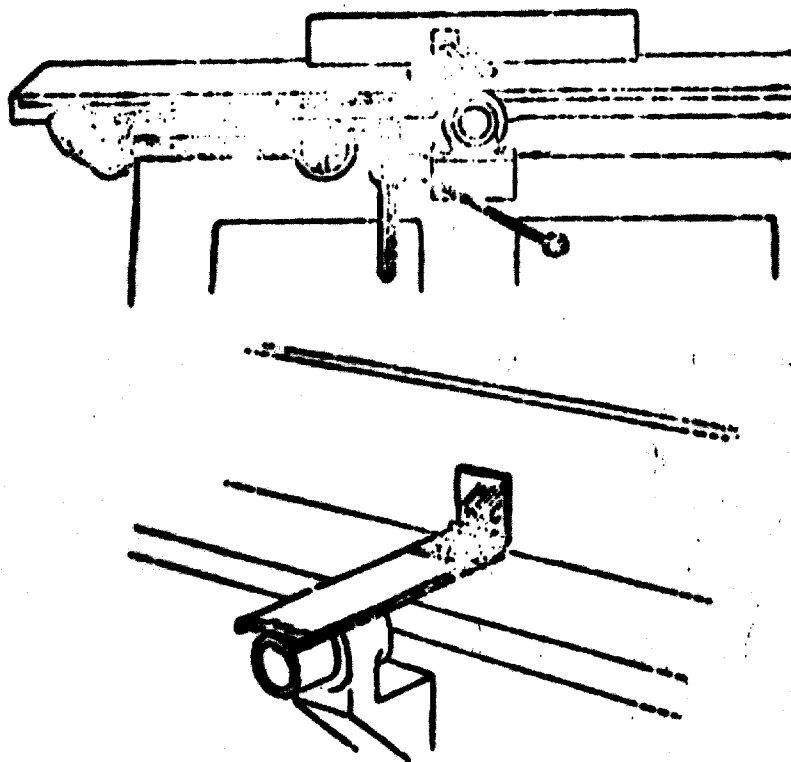


Fig. 8

Sub-guard for a smooth planer and a guard for the back part of the cutter

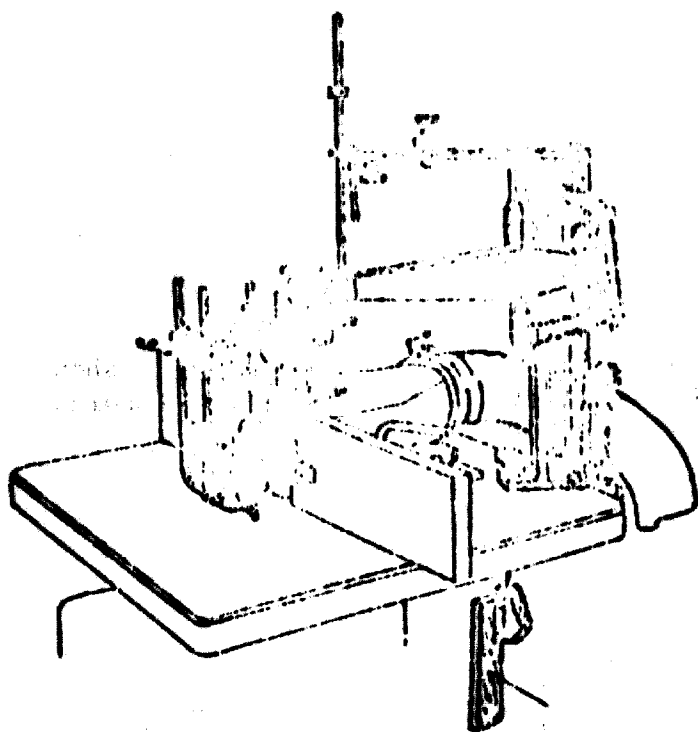


Fig. 9
SUVA-guard and exhaust hood for a miller

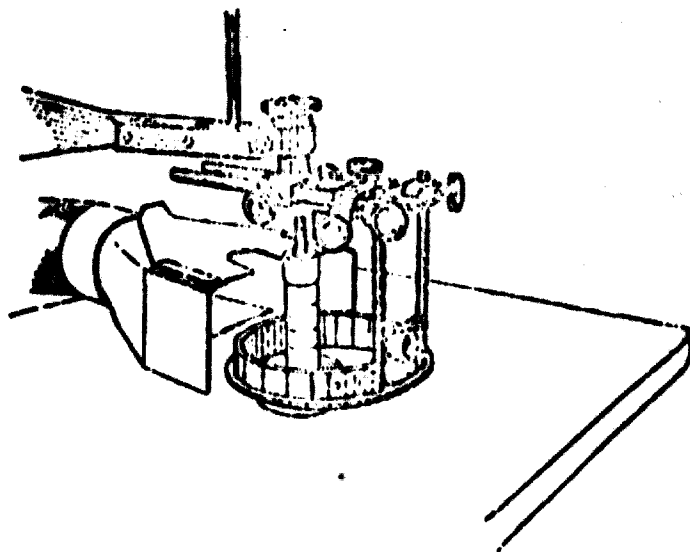


Fig. 10
A circular guard for a miller





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